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Environmental & Water-Resource Consultants

Memorandum

Date: September 18, 2019

From: Erica DiFilippo and Matt Tonkin (SSP&A)

To: Judy Canova and David Wilson (USEPA Region V)

Project: SSP-1453, Task 39

Subject: **Data Gap Summary – Pristine, OH – September 2019**

S.S. Papadopulos & Associates, Inc. (SSP&A) has reviewed groundwater chemistry and elevation data for the Pristine, Inc. Superfund Site (herein referred to as the Site) to determine if sufficient data exist to evaluate monitored natural attenuation (MNA) of volatile organic compounds (VOCs). Extensive groundwater remediation and monitoring has been conducted at the Site since the early 1990's and remedial operations and maintenance activities are still ongoing. Remedial actions have included demolition of decontamination of former structures, thermal soil treatment, in-situ soil vapor extraction (ISVE), soil cap construction, installation of a pump-and-treat groundwater extraction system and installation of groundwater monitoring wells in both the Upper Aquifer (UA) and the Lower Aquifer (LA) (GHD, 2019a). The ISVE system operated from 1997 to 2009 and included a shallow groundwater dewatering system which facilitated soil vapor extraction. The dewatering portion of the ISVE system operated from 1997 to 2017. The pump-and-treat system consists of one extraction well in the UA (GW108), which has been operational since 2008, and five extraction wells (EW1 through EW5) in the LA, which have been operational since 1997. Extraction wells GW108 and EW1 are located within the Site boundary and extraction wells EW2 through EW5 are located south of the Site in the general direction of groundwater flow. After two years of operating the pump-and-treat system, concentrations of total VOCs began to decrease in both UA and LA monitoring wells. In March 2002, pumping rates in the LA were reduced due to the concern that the off-Site pumping wells were drawing in non-Site-related contamination. Due to the observed decreases in concentration and concern that the off-Site pumping wells were drawing in non-Site-related contamination, shutdown of the off-Site LA extraction wells began in 2006 with the shutdown of extraction wells EW2 and EW4. Extraction well EW3 was shutdown in late-2008 and extraction well EW5 was shutdown in mid-2011.

A monitored natural attenuation (MNA) pilot program was initiated in 2011, after shutdown of the final off-Site LA extraction well (GHD, 2017). The goal of this pilot program was to show that MNA was occurring within the off-Site LA groundwater system, resulting in stabilization of the contaminant plume. After several years of the pilot program, the progress of MNA was evaluated by conducting a Mann-Kendall Trend Test for the VOCs sampled at each monitoring location for data collected between 2013 and 2016. This study found insignificant or decreasing trends in most monitoring wells but did find statistically significant increasing trends for select VOCs in wells

MW100 and MW103, located near the southern (i.e., downgradient, or leading) edge of the monitoring network.

SSP&A produced a report in February 2018 which evaluated plume maps for 1,2-DCA; conducted additional trend analysis that accounted for changes in groundwater conditions resulting from the shutdown of the off-Site LA extraction wells; completed groundwater-level mapping; undertook three-point gradient analysis to determine if the existing monitoring network was sufficient to monitor for migration and attenuation of VOCs associated with the Site; evaluated the impact of nearby pumping on groundwater flow; determined the capture zone of the one remaining extraction well in the pump-and-treat system, and; evaluated the potential migration of contaminated groundwater in the Off-Site area. This report also included an evaluation of data gaps and identified five areas at the Site where available data and monitoring wells were insufficient to fully understand plume migration in the LA and the efficacy of MNA. SSP&A found that increasing trends and increased detection frequencies along the downgradient edge of the groundwater monitoring network had met the requirements set in the MNA workplan for re-instating the pump-and-treat system and that current groundwater flow rates were insufficient to balance natural attenuation rates and prevent continued migration of the groundwater plume.

Following SSP&A's 2018 report, off-Site LA extraction well EW4 was turned on in October 2018 at a rate of approximately 50 gpm in an attempt to balance groundwater flow and natural attenuation rates and prevent further migration of the groundwater plume. Groundwater data, including groundwater elevation and groundwater chemistry, have continued to be collected in both the UA and the LA.

This technical memorandum provides an update of the data gap analysis performed in SSP&A's 2018 report. While the original data gaps identified in SSP&A's 2018 report remain the same, the updated data gap analysis presented below provides either: (1) additional supporting evidence for one of the original data gaps identified in SSP&A's 2018 report, or; (2) identification of a new data gap based on an updated analysis.

Data Gaps

1. South-western side of the current LA monitoring network[1].

   Data Gap: The current groundwater monitoring network is insufficient for monitoring the continued southwestern expansion of the 1,2-Dichloroethane (1,2-DCA) groundwater plume.

[1] Data gap originally identified in SSP&A's 2018 MNA report.

<u>*Supporting Data and Analysis:*</u> LA monitoring wells MW100 and MW104 both show increasing trends in 1,2-DCA. Increasing trends were identified in both wells in SSP&A's 2018 report and data collected after February 2018 confirm the continued increase in concentration (Figures 1 and 2). Concentrations of 1,2-DCA have increased above the maximum contaminant level (MCL) of 5 µg/L at monitoring well MW100 and, based on the Tobit regression model, concentrations are on track to increase above the MCL at monitoring well MW104 in the next few years[2]. Both wells are screened in the deeper portion of the LA. The shallower portion of the LA, represented by MW105, does not show signs of contamination by 1,2-DCA. Neither monitoring wells MW100 or MW104 had detections for chloroethane, the degradation product of 1,2-DCA.

[2] Monitoring well MW104 is sampled annually and the 2019 groundwater chemistry sample was not available at the time of this memo.

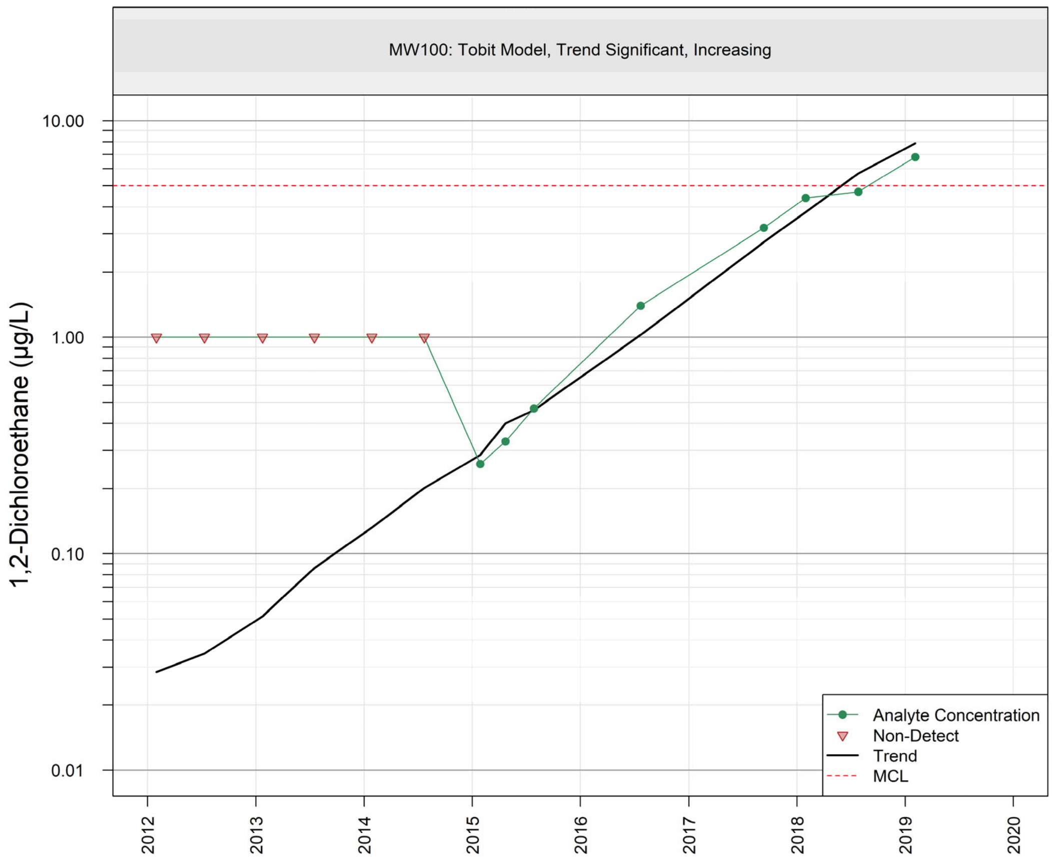

Figure 1. 1,2-DCA concentrations in well MW100.

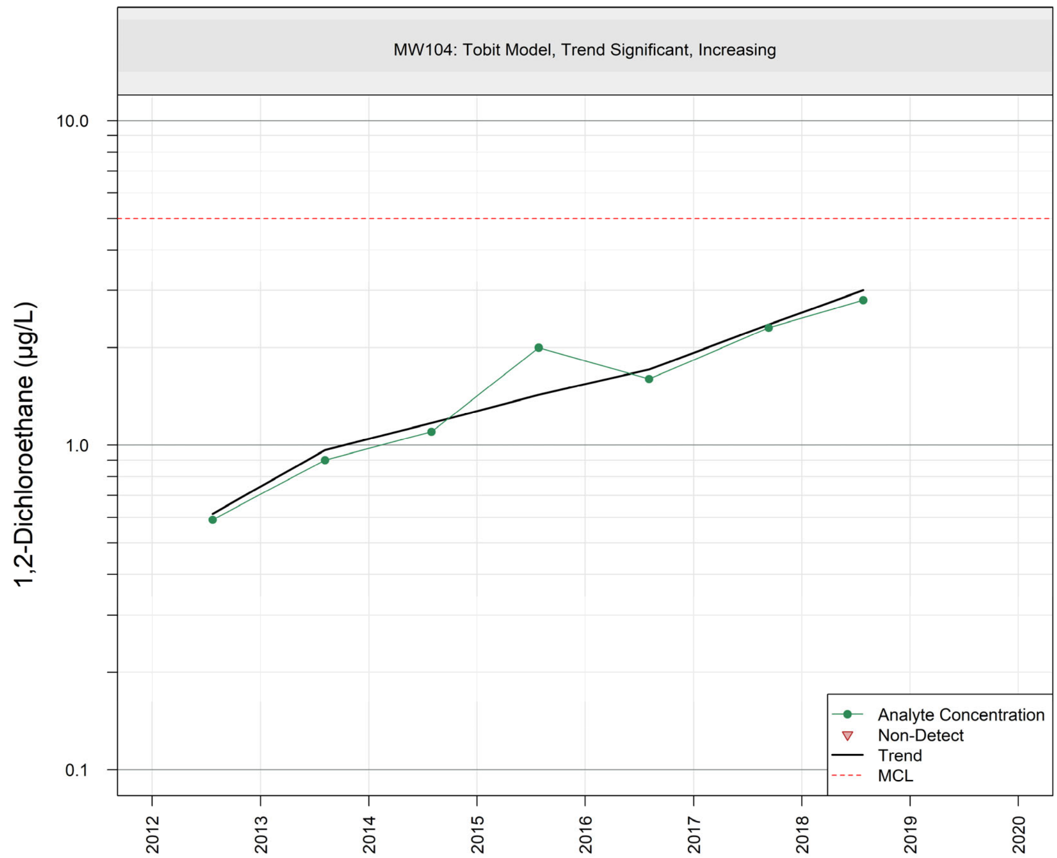

Figure 2. 1,2-DCA concentrations in well MW104.

Changes in the aerial extent of 1,2-DCA above 1 µg/L (the method detection limit) between 2016 and 2018 are evident in Figure 3. The southwestern extent of 1,2-DCA has increased from 2016 (presented as Figure 5 in SSP&A's 2018 MNA report) to 2018, due to the increasing trends noted at wells MW100 and MW104 (Figures 1 and 2).

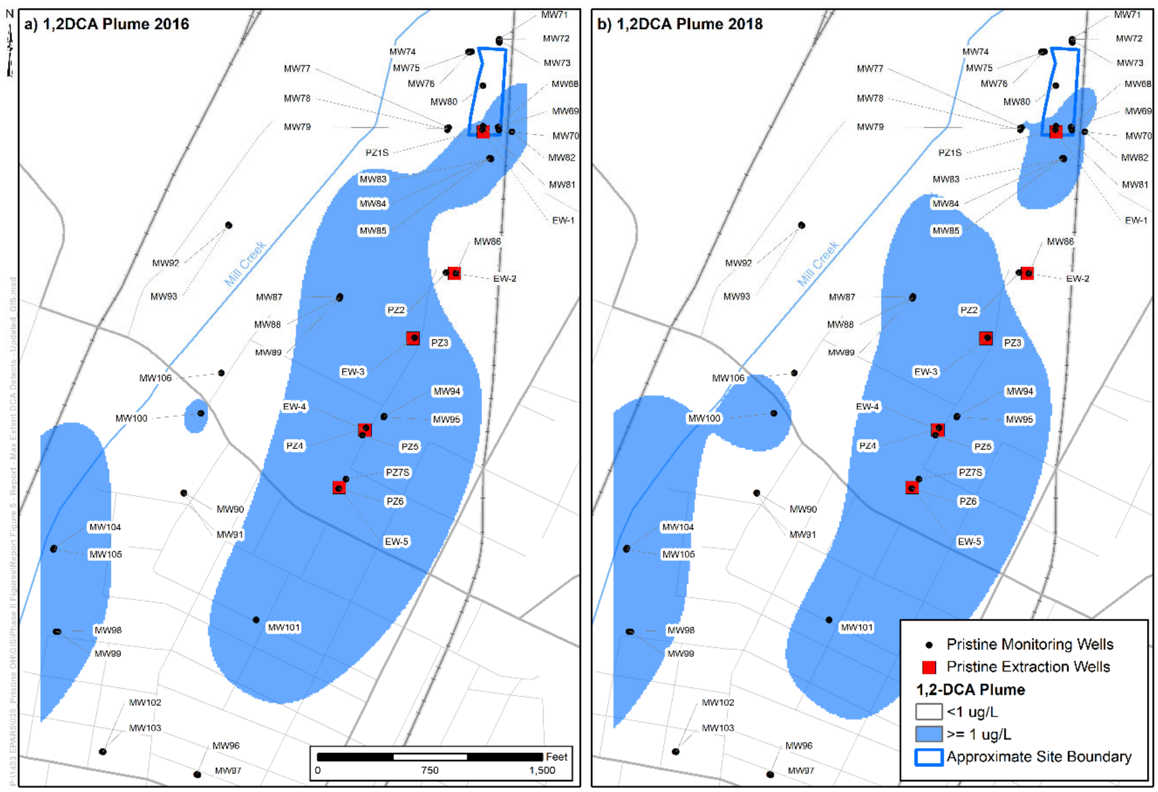

Figure 3. Concentrations of 1,2-DCA greater than 1 µg/L in 2016 and 2018.

In a memorandum to the Pristine Trustees in June 2019, GHD suggested that wells from the GE Aviation site monitoring network[3] would be sufficient for monitoring continued migration of the 1,2-DCA plume to the southwest past the current Pristine groundwater monitoring network (GHD, 2019b). Use of the GE monitoring network to satisfy this data gap is dependent upon:

- The appropriateness of the screened intervals of the identified GE wells because well cluster MW104/105 indicates that contaminants are migrating only in the deeper portion of the LA;

[3] GHD identified GE Aviation Site monitoring wells H-218, H-219, H-220 and OS-MW5D as suitable for monitoring continued expansion of 1,2-DCA to the southwest of the current Pristine groundwater monitoring network.

- GE's agreement to continue to maintain these wells in their monitoring network;
- GE's agreement to continue to monitor these wells for 1,2-DCA, which is a Pristine Site-specific contaminant;
- GE's continued cooperation with the Pristine Site for sharing groundwater data.

If any one of these is not met, then the GE monitoring network will not be appropriate for satisfying this data gap. It should be noted GE monitoring well OS-MW5D is screened from 430 – 440 ft amsl, while Pristine monitoring wells MW100 and MW104, where increasing trends have been identified, are screened from 400 – 410 and 406 – 416 ft amsl, respectively. Therefore, well OS-MW5D is not screened appropriately for monitoring migration of contamination present in wells MW100 and MW104.

2. Eastern side of the current LA monitoring network[4].

   Data Gap: The current groundwater monitoring network is insufficient for monitoring the eastern extent of the 1,2-Dichloroethane (1,2-DCA) groundwater plume.

   Supporting Data and Analysis: The interpolated aerial extent of 1,2-DCA concentrations above 1 µg/L are shown on Figure 3 above. This map clearly shows that 1,2-DCA concentrations above 1 µg/L likely extend eastward beyond the current monitoring well network. In addition, monitoring locations on the eastern edge of the 1,2-DCA plume, such as MW95 and PZ3, consistently exhibit concentrations of 1,2-DCA above the MCL. Well MW95 has the highest concentrations of 1,2-DCA in the off-site area post-2011 (i.e., 20 to 300 µg/L), which are consistently above the maximum contaminant level (MCL) of 5 µg/L. Recent samples collected from PZ3 also show concentrations of 1,2-DCA consistently above the MCL. These locations do not constrain the eastern extent of the plume (i.e., the eastern extent of 1,2-DCA concentrations exceeding the MCL is unknown).

3. Area near LA monitoring wells MW87/88/89, MW90/91 and MW100[5].

   Data Gap: Groundwater flow and transport in the vicinity of LA monitoring wells MW87/88/89, MW90/91 and MW100 is poorly understood.

   Supporting Data and Analysis: LA monitoring well MW87 has continually had concentrations of 1,2-DCA above the MCL of 5 µg/L since 2013 (Figure 3). While there is no statistically significant trend at this location, indicating that plume is not expanding,

[4] Data gap originally identified in SSP&A's 2018 MNA report.
[5] Data gap originally identified in SSP&A's 2018 MNA report.

the lack of a decreasing trend indicates that: (1) the source of 1,2-DCA to this well is steady, and/or; (2) degradation is not occurring at a sufficient-enough rate to reduce concentrations.

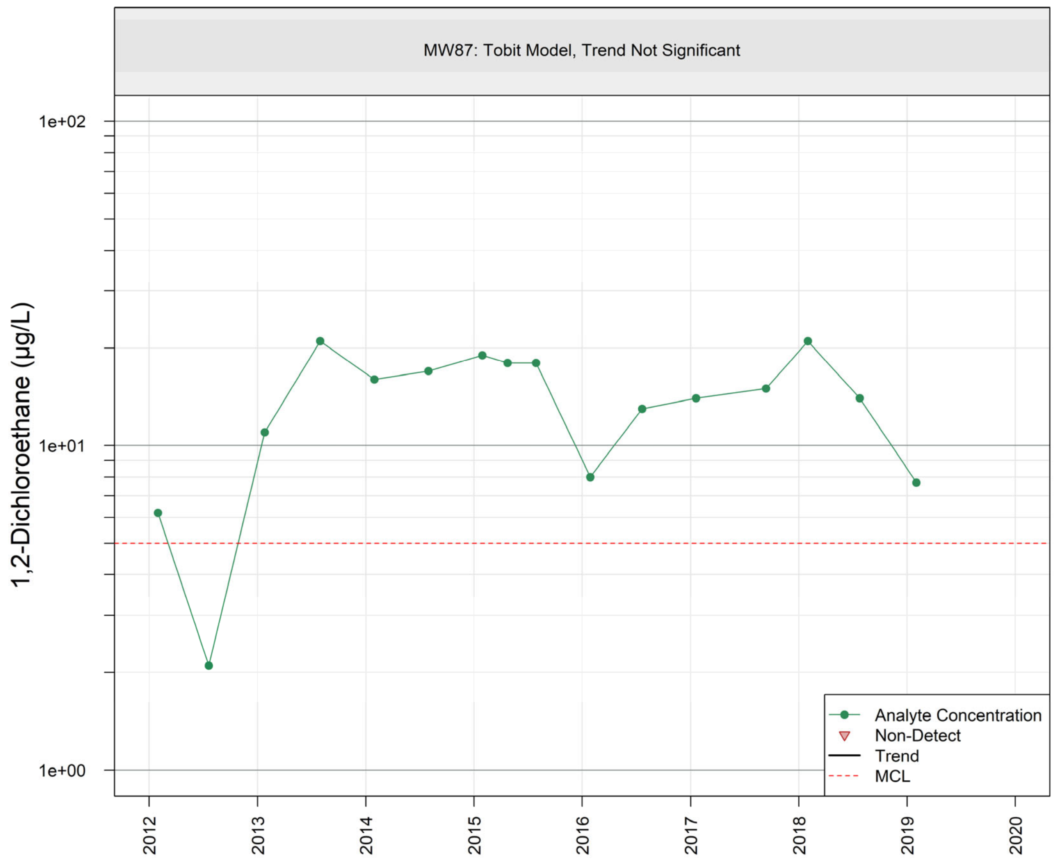

Figure 3. 1,2-DCA concentrations in well MW87.

Concentrations of 1,2-DCA at LA monitoring wells MW88 and MW89 are, with the exception of one sample in 2013 in LA monitoring well MW89, below the MCL of 5 µg/L and neither well shows a statistically significant trend (Figures 4 and 5). Concentrations are lowest in LA monitoring well MW87 (generally below 1 µg/L) and concentrations are higher in well LA monitoring well MW89 (generally between 1 and 2 µg/L).

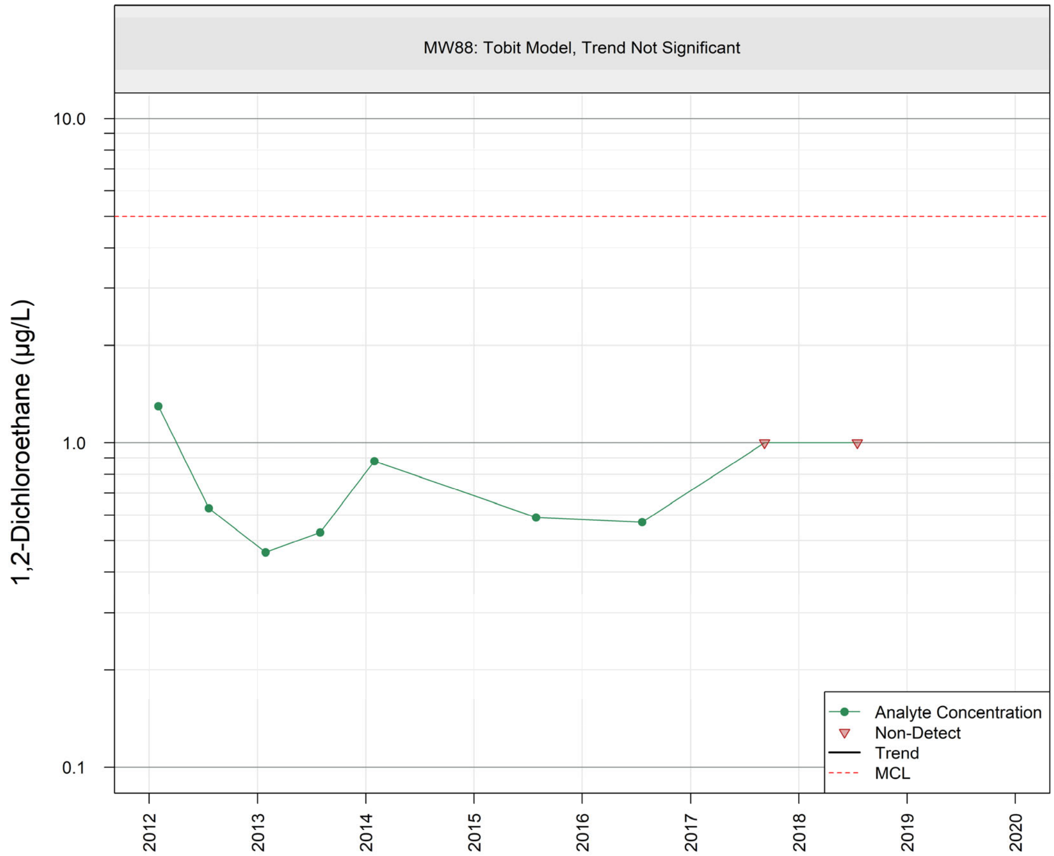

Figure 4. 1,2-DCA concentrations in well MW88.

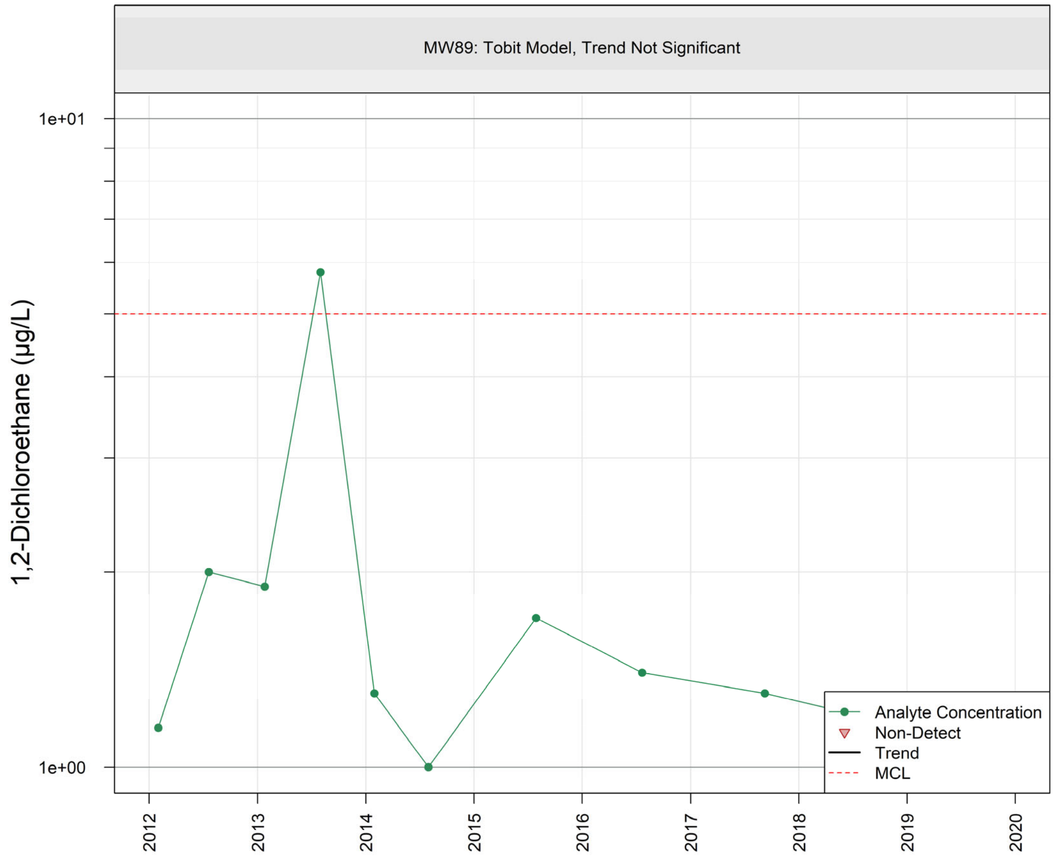

Figure 5. 1,2-DCA concentrations in well MW89.

LA monitoring wells MW87, MW88 and MW89 are a part of a well cluster, with each well screening from a different depth in the aquifer. MW87 is screened in the shallowest portion of the LA, MW89 is screened in the deepest portion of the LA and MW88 is screened between wells MW87 and MW89 (Figure 6).

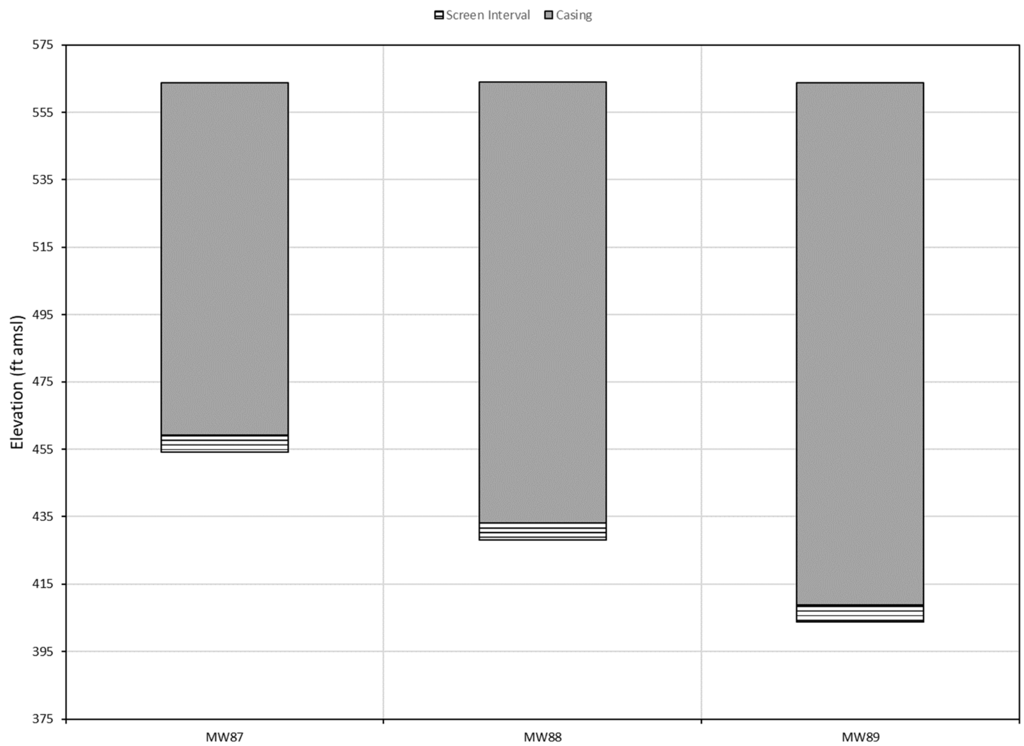

Figure 6. Screened intervals for LA monitoring well cluster MW87/88/89.

Even though LA monitoring well MW88 is screened at an intermediate depth between MW87 and MW89, it consistently as the highest measured groundwater elevations (Figure 7). Therefore, vertical flow from the shallow portion of the LA to the deep portion of the LA is not occurring in the vicinity of this well cluster and cannot explain the bifurcated nature of the measured 1,2-DCA plume in this area (MW87 > MW89 > MW88).

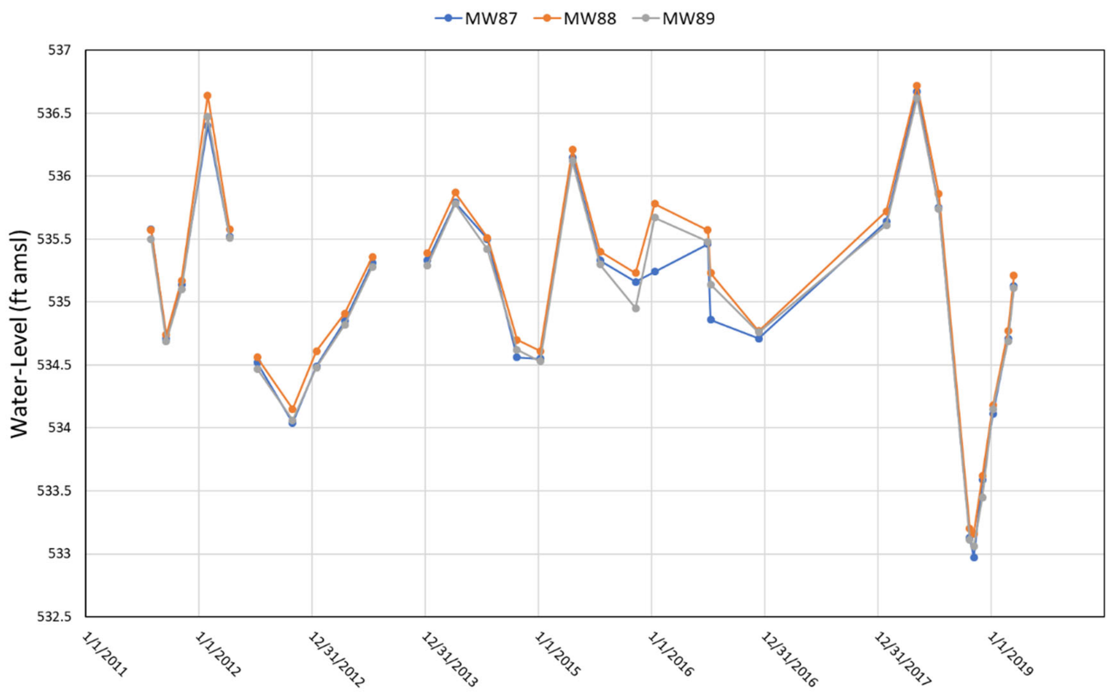

Figure 7. Measured groundwater elevation at LA monitoring well cluster MW87/88/89.

Based on recent (post-EW5 shutdown) detections of 1,2-DCA, it appears that the 1,2-DCA plume is migrating along the western edge of the off-site area in the LA, however, particle tracks from both modeling and measured water-levels do not indicate a clear pathline between the on-Site source and these locations. This is likely due to the suggestion of a slight eastward component of groundwater flow in this area, based on the measured data. This eastern component of flow exists even without pumping in the off-Site extraction wells (Figure 8). A better understanding of groundwater flow is needed in this area as it is clear from the chemistry data that migration is happening along this corridor.

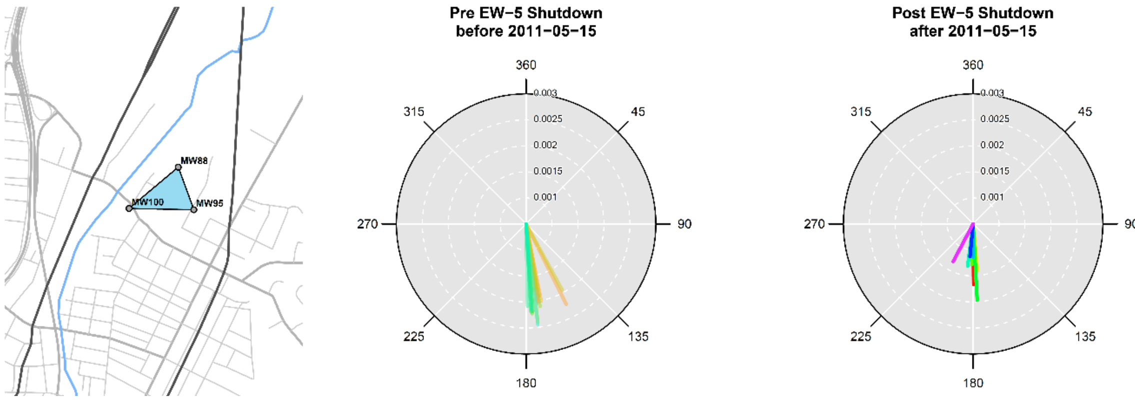

Figure 8. Hydraulic gradient and flow direction in vicinity of LA monitoring wells MW87/88/89, MW100 and MW91/92.

4. On-Site area connection between the UA and the LA and potential presence of a continuing source in the UA[6].

   Data Gap: The hydraulic connection between the UA and LA in the vicinity of the on-Site area is not fully understood and evidence indicates that a continuing source is present in the UA of the on-Site area.

   Supporting Data and Analysis: LA monitoring well cluster MW77/78/79 is located adjacent to the Site boundary, southwest of the ISVE Zone B and the Magic Pit. Concentrations of 1,2-DCA decreased in the wells within this cluster from the late 1990's through 2011. Post-shutdown of the off-Site extraction wells, concentrations of 1,2-DCA have increased in well MW77 and show no indication of stabilizing or decreasing (Figure 9). MW79, the deepest screened well in the cluster, had increasing concentrations of 1,2-DCA from 2015-2017 (Figure 10) and the 2017 sample was above the MCL of 5 µg/L[7]. MW77 is the shallowest well in this cluster and increases in 1,2-DCA could indicate continued migration from the UA in the on-Site area.

[6] New data gap identified in this memorandum.
[7] The sampled collected in 2018 was non-detect

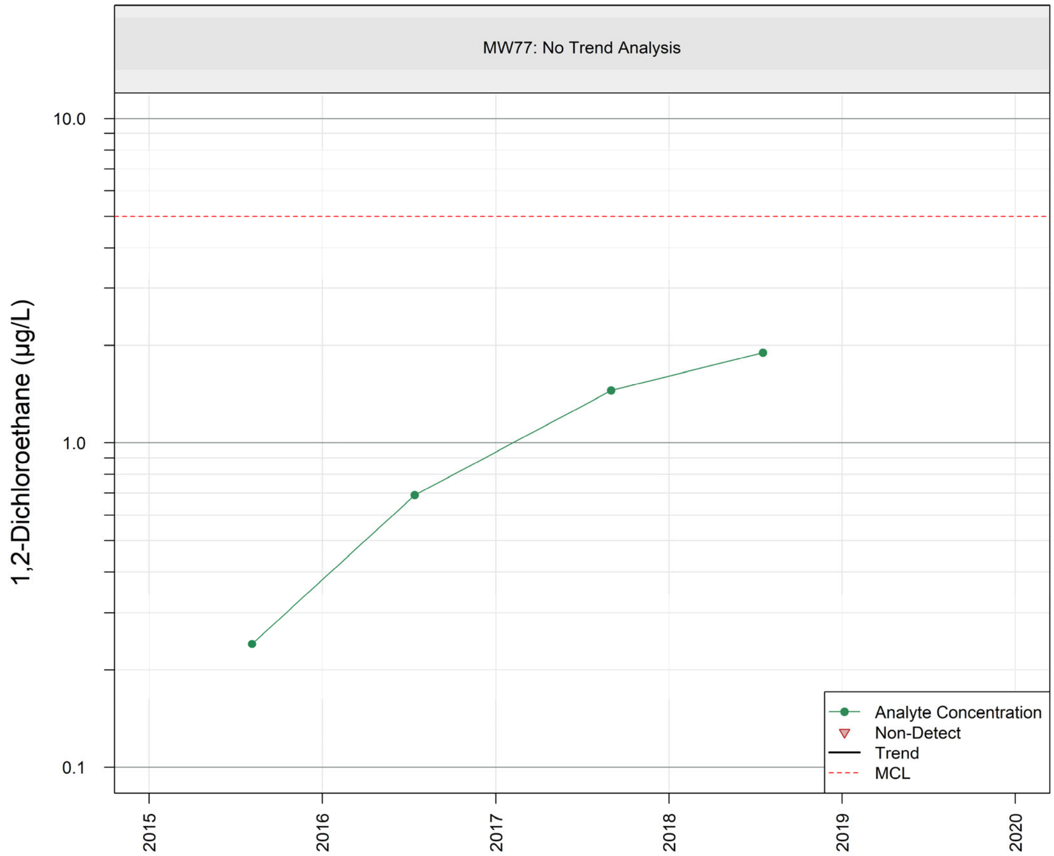

Figure 9. 1,2-DCA concentrations in well MW77.

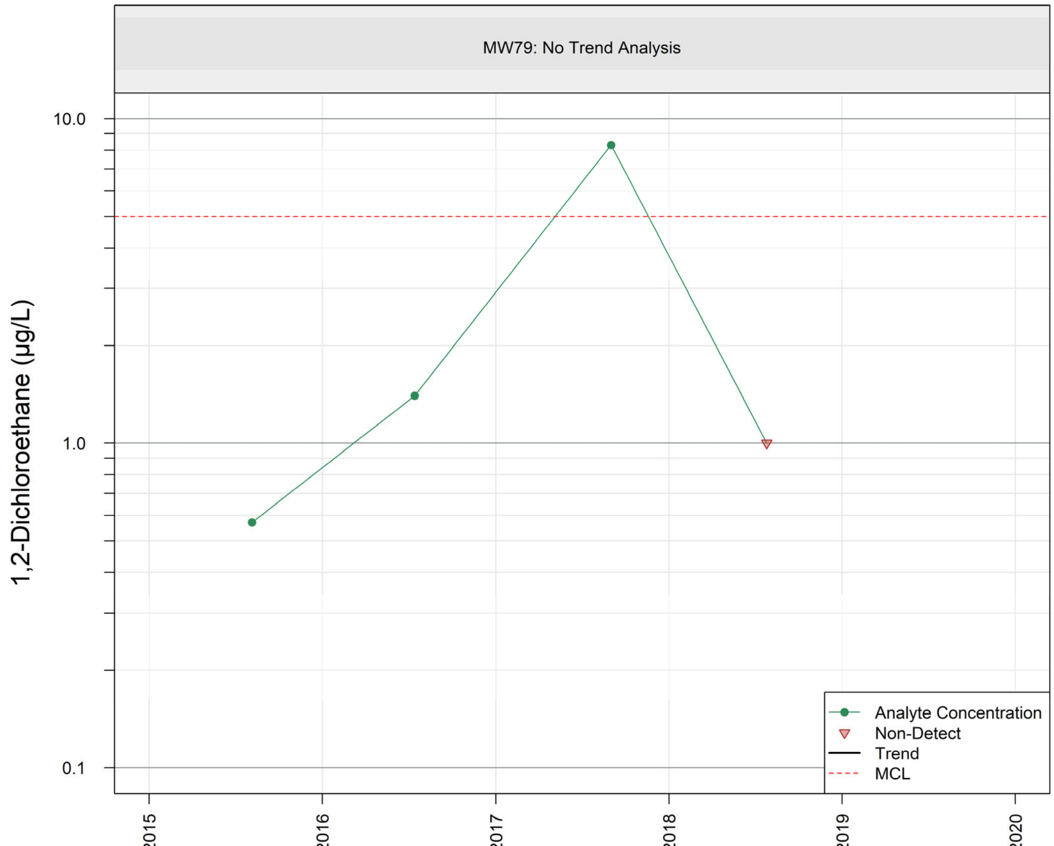

Figure 10. 1,2-DCA concentrations in well MW79.

At UA monitoring well GW53, located along the western edge of ISVE Zone A, concentrations of 1,2-DCA have been increasing since 2011 and concentrations have exceeded the MCL of 5 µg/L since 2015 (Figure 11). Concentrations of 1,2-DCA have remained steadily above the MCL of 5 µg/L at UA monitoring well GW63, also located along the western edge of ISVE Zone A just south of GW53, since 2011 (typically between 200 – 600 µg/L[8]) (Figure 12). UA monitoring wells GW64, GW65, GW66 and GW109, all located along the eastern boundary of the Site, have all had sporadic samples with concentrations of 1,2-DCA above the MCL. Continued exceedances of the MCL likely indicates an active source in the UA of the on-Site area.

[8] The sample collected in 2016 had a 1,2-DCA concentration of ~60 µg/L.

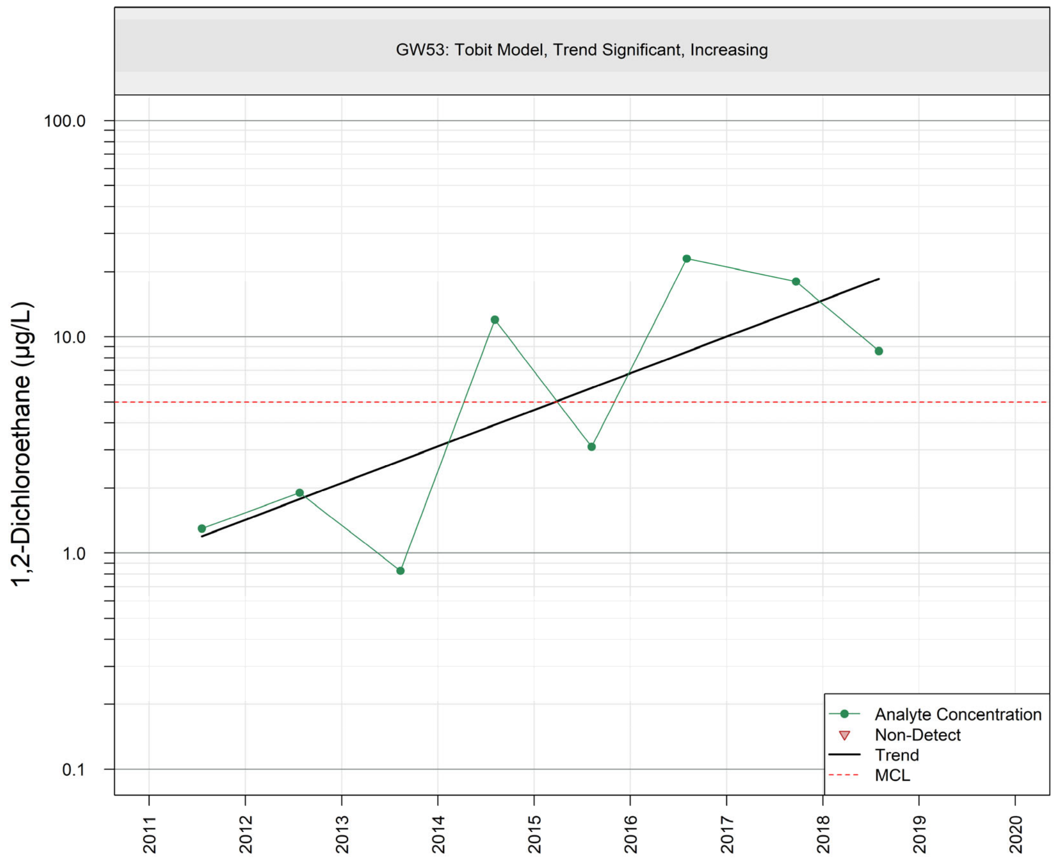

Figure 11. 1,2-DCA concentrations in well GW53.

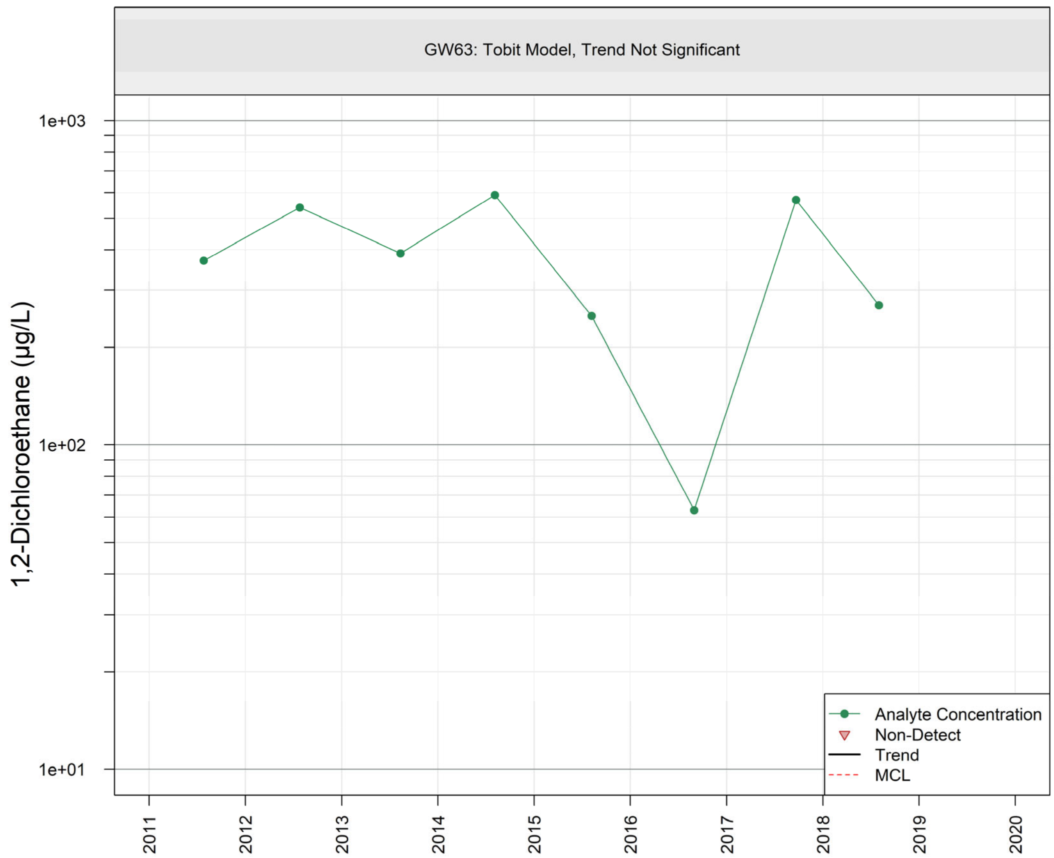

Figure 12. 1,2-DCA concentrations in well GW63.

5. Sampling frequency[9].

   Data Gap: The current annual sampling frequency for LA monitoring wells along the southern perimeter of the monitoring network is in sufficient for evaluating plume expansion.

   Supporting Data and Analysis: Currently some crucial wells, such as MW104 and MW100, are only sampled once a year. These wells have increasing trends for 1,2-DCA

[9] New data gap identified in this memorandum.

and need to be sampled more frequently (quarterly) in order to monitor for changes that are occurring at these locations. Quarterly sampling is also recommended at the MW87/88/89 cluster, MW98/99, MW106, MW101, MW96/97 and MW102/103.

Measurements of groundwater elevation should also be conducted on a quarterly basis in order to evaluate the impact of pumping at EW4 on groundwater flow direction and gradients.

6. MNA rates[10]

<u>*Data Gap:*</u> Currently, the rate of monitored natural attenuation is unknown.

<u>*Supporting Data and Analysis:*</u> While some wells in the LA have no statistically significant trend for 1,2-DCA, there are no wells that show a statistically significant decreasing trend. Therefore, based on the groundwater chemistry data alone, it is not possible to assess the rate of degradation of 1,2-DCA in the LA. To properly assess the impact of MNA at the Site, a comparison between degradation rates and groundwater flow rates is needed. The plume would be considered stable if the rate of degradation is equal to the rate of groundwater flow. The plume would be considered shrinking if the rate of degradation exceeded the rate of groundwater flow. Without a proper assessment of the degradation rate, it is difficult to determine what reduction is groundwater flow rate is needed to contain the plume and stop expansion.

Prior to shutdown of LA extraction well EW5, both wells LA monitoring wells MW104 and MW100 were non-detect for 1,2-DCA. Once extraction well EW5 was shutdown, concentrations in both wells started to increase. Part of this increase is most likely due to the change in groundwater flow direction, which changed by 47 degrees. The other likely cause of the observed increases in 1,2-DCA are changes in hydraulic gradient, which increased by 0.00583 ft/ft (Figure 13). If it is assumed that plume migration was contained when LA extraction well EW5 was pumping (hydraulic gradient of 0.00146 ft/ft) it was no longer contained post-shutdown (hydraulic gradient of 0.00729 ft/ft). Therefore, the optimal hydraulic gradient for containing plume migration in this area is between 0.00146 and 0.00729 ft/ft. In October 2018, LA extraction well EW4 was turned on at a rate of approximately 50 gpm. This resulted in a decrease in the hydraulic gradient of 0.00283 ft/ft (mean gradient post-EW4 turning on is 0.00446 ft/ft) (Figure 14). However, concentrations of 1,2-DCA in MW100 continue to increase and show no indication that

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[10] Data gap identified in SSP&A's 2018 MNA report.

turning on LA extraction well EW4 had any impact on the rate of increase in concentration. Therefore, a hydraulic gradient of 0.00446 ft/ft is likely insufficient for preventing continued migration of 1,2-DCA along the western edge of the plume. Therefore, the optimal hydraulic gradient for containing plume migration in this area is between 0.00146 and 0.00446 ft/ft. Increasing the pumping rate for EW4 is suggested to determine if the hydraulic gradient in this area can be further reduced.

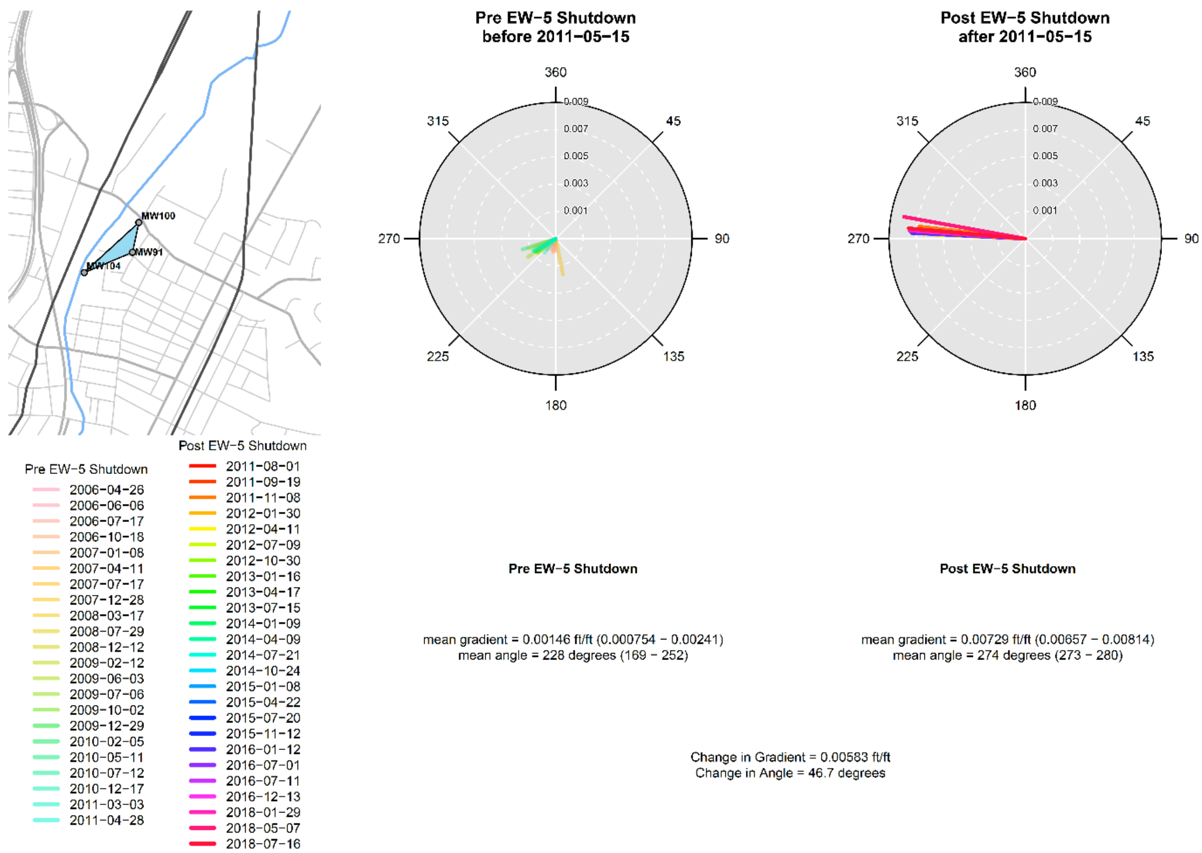

Figure 13. Change in hydraulic gradient and groundwater flow direction pre- and post-shutdown of LA extraction well EW5.

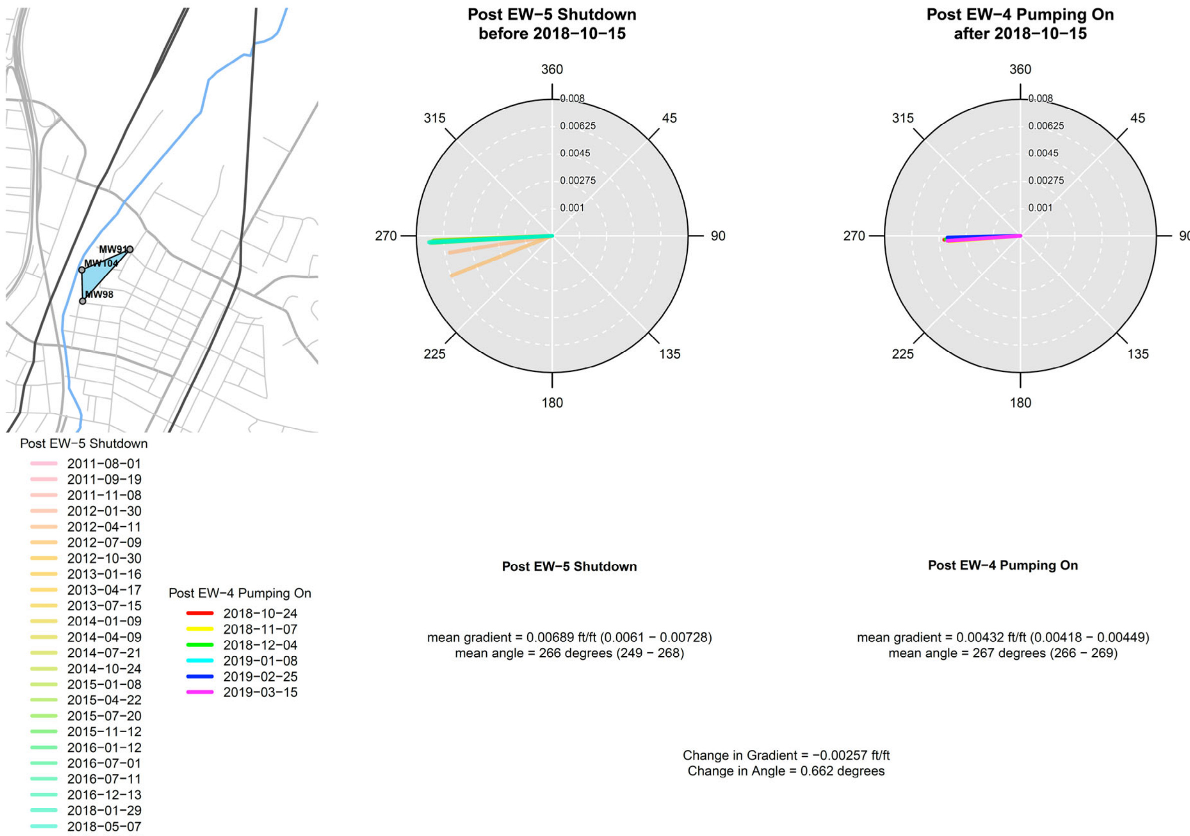

Figure 14. Change in hydraulic gradient and groundwater flow direction before and after turning on extraction well EW4 in October 2018.

References

GHD, 2017. Monitored Natural Attenuation (MNA) Pilot Program Data Evaluation Report, April 21, 2017. 399 pp.

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GHD, 2019b. Memorandum from Julian Hayward/Alan Deal/lj/429 to Pristine Trustees. Re: SSPA Report Entitled "Evaluation of Monitoring Natural Attenuation Pristine Superfund Site, Reading Ohio". 11 pp.

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